connected together over a backplane (40) through module connectors (42) in order to form a three-dimensional torus network (20):

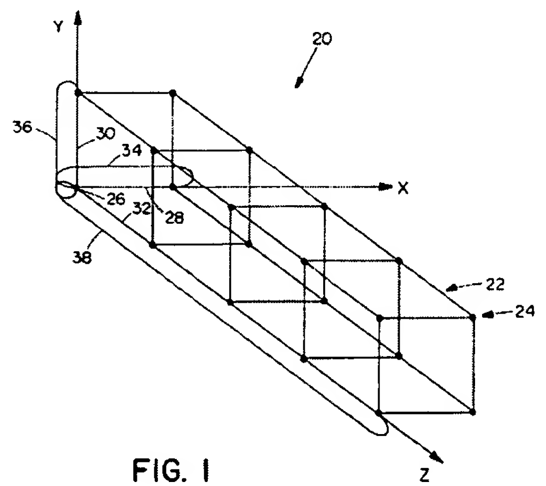


FIG. 1

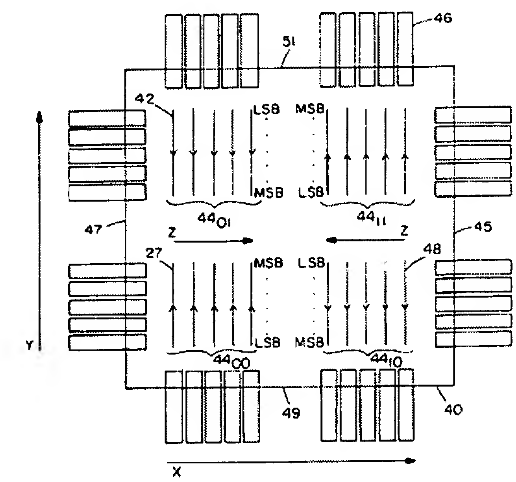


FIG. 2

The invention of Carvey is to use flexible configuration boards (46) on the backplane (40) to link individual modules (24 & 26) and even separate backplanes (40) together in an easily reconfigurable manner. <u>See, e.g.,</u> Carvey, col. 15, lines 46-67. Carvey does not expressly mention the construction of the individual modules (24 & 26). In particular, as it relates to the present invention, Carvey does not discuss any input/output modules that form part of the individual modules (24 & 26). However, as pointed out in the office action, Carvey incorporates Dally, which details the construction of a switch router module that can be connected together over the torus network (20) of Carvey. The Dally switch router modules are best understood by examining Figures 8 and 9 of Dally:

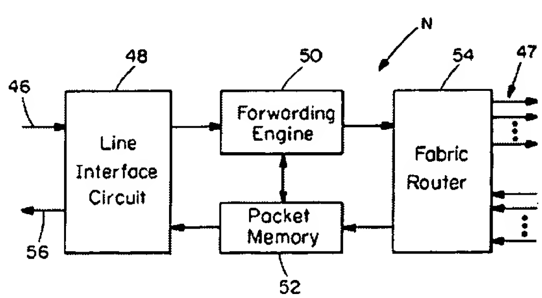


FIG. 8

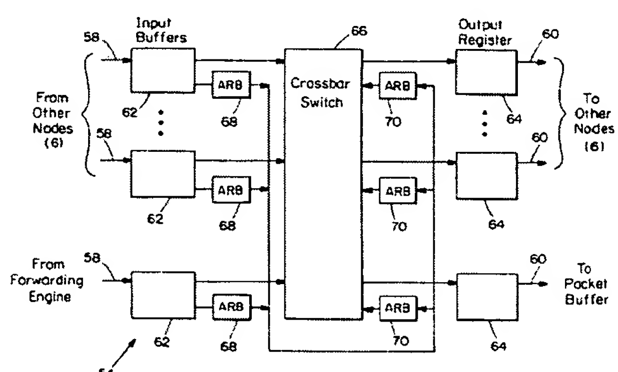
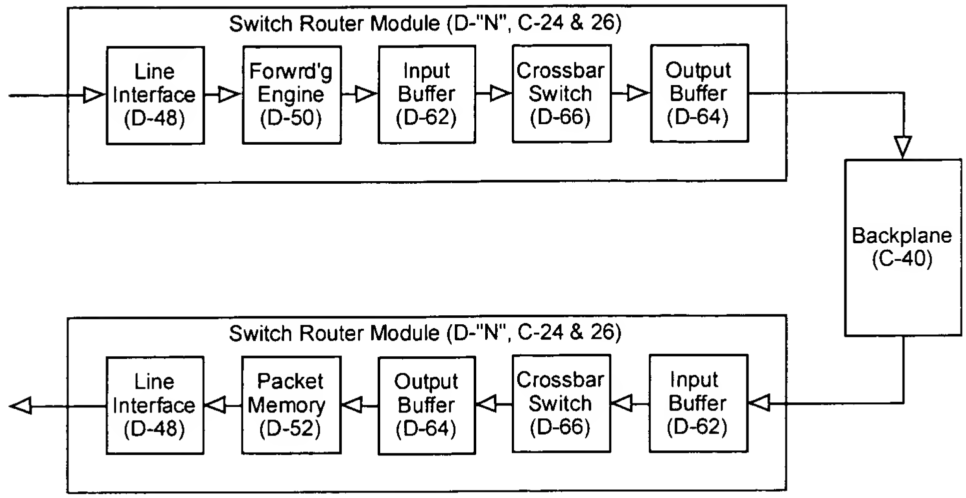


FIG. 9

Figure 8 of Dally shows the construction of a switch router module that is designed specifically for use in a torus network like that described in Carvey. Dally, col. 6, lines 30-39 & Fig. 7. More specifically, Dally intends that these individual switch router modules or nodes (N) be combined to form a single internet router, through which data will hop across multiple switch router modules in its pass through the internet router. Dally, col. 2, lines 47-54. These router modules (N) connect to a SONET internet input link (46) and a SONET internet output link (56) via a line interface circuit (48). Dally, col. 6, lines 40-45. This circuit converts optical signals to electrical signals, extracts packets and headers from the incoming stream, and forwards this information to the forwarding engine (50). Id. The forwarding engine uses the header to route the packet through the fabric array. Dally, col. 6, lines 46-55. The forwarding engine routes the data through all of the necessary hops through the switch router modules at once, creating a routing map of up to ten "hop fields" which indicate the path to be taken across up to ten switch router modules. Dally, col. 7, lines 1-11. The forwarding engine then submits the packet along with its destination and routing map to the fabric router (54), which is shown in detail in Figure 9 of Dally. The fabric router receives information from either the forwarding engine (50) or other nodes (N) and places this information in input buffers (62). From these buffers, the data is transmitted over the crossbar switch (66) using the routing information created by the forwarding engine when the data first entered the internet router. The crossbar switch sends data to the appropriate output buffers (64) based on the routing information. The output buffers are connected either to other nodes (N) or to the output (56) of the current node through packet memory (52) and the line interface circuit (48). Dally, col. 7, lines 21-33.

As seen above, the combined invention of Carvey and Dally teach the use of Carvey's backplane to connect the switch modules of Dally in a flexible, easily changeable torus network. Schematically, data flow over the Carvey/Dally disclosure can be diagramed as follows:



In this two-hop example, data enters the first switch router module (N) of Dally at the line interface circuit (40), and is routed at the forwarding engine (50). Data then enters the input buffer (62) of the fabric router (54). Using the routing information, the data passes through the crossbar switch (66) into the output buffer (64) appropriate to send the data to the next switch router module. It is here that the backplane (40) of Carvey is utilized to transmit the data to the next router module. At the second switch router module, the data directly enters the input buffer (62) without being routed through the forwarding engine due to the one time routing. The crossbar switch routes the data to the output buffer for the local output line. The data passes through the packet memory (52) and through the line interface (48) to the internet output 56.

As can be seen in this example, the invention of Carvey provides a (very flexible) technique for linking together switch router modules. Nonetheless, Carvey does not avoid passing data through the crossbar switch of each switch router module. Nowhere does Carvey discuss or suggest directly accessing the input/output modules found within these router modules. Instead, every encounter with a switch router module constitutes a "hop" through a multi-switch fabric. See Dally, col. 5, lines 44-50. In contrast, the independent claims 1 and 16 of the present invention involve a unique method of connecting between two backplanes in order for a switching module residing on one backplane to directly connect to the input/output modules residing on another backplane. This invention is not taught or suggested in the combined Carvey and Dally references.

More particularly, amended claim 1 defines the present invention as having a first and second backplane. Each backplane has a set of input/output modules and a set of switching modules. Furthermore, each backplane establishes direct connections

between the ports on the input/output modules and the switch modules on the backplane. In this way, each backplane is conceptually similar to a single switch router module in Dally.

Claim 1 also includes a direct connection between the input/output modules of the second backplane to the switching module of the first backplane. This direct connection allows a switching module on one backplane to provide direct connections to the Fibre Channel ports on the input/output modules of the other backplane. It is this direct connection that clearly distinguishes the present invention from the cited prior art. As seen above, the Dally/Carvey invention does allow data to enter an input of a first Dally switch router module and exit an output of a second switch router module. However, that data must pass through the entirety of the first switch router module, pass over the backplane, and then pass through the entirety of the second switch router module. This means that data must pass through the crossbar switch of both switch modules to pass through the system. In the invention of the amended claims, the direct connection allows data received at an input/output module of the first backplane to be directly connected to the switch module on a second backplane. The present invention allows the data to by-pass the switch module of the first backplane. In effect, the data passes in a single "hop" and avoids the overhead and delays of passing through the first switch module. In so doing, the present invention creates a single, higher port count switch using switch modules that reside on different backplanes, while Dally/Carvey simply uses a backplane to connect multiple switches together in a single fabric.

Independent claim 16 is similar to claim 1, except that the first input/output modules, switch modules, and backplane reside in a first chassis, and a direct communication is provided between the input/output modules of a second chassis and the fabric switch modules of the first chassis. This claim should be considered patentable for the same reasons set forth above in connection with claim 1.

In summary, the invention of claims 1 and 16 differs from the prior art in that the claimed invention creates a single, higher port count switch using switch modules and input/output modules that reside on different backplanes. This is accomplished by the direct connection between the input/output modules of one backplane with the switching modules of a second backplane. This is not found in the teachings of Carvey

and Dally. Instead, these references teach the use of a backplane to connect multiple switches together in a multi-switch fabric.

Rejection under 35 U.S.C. §102(e): Claims 34-41

Claims 34-41 were added in the Applicant's previous response, and were examined for the first time in the final office action. These claims are directed to a Fibre Channel switch having input/output modules and switching modules sharing a single chassis. Claim 34 requires a hardwired connection between each input/output module and each switching module within a chassis. In addition, claim 34 requires a jumper connection site with jumper connections leading from the jumper connection site to each input/output module and each switching module. In this way, the jumper connection site can be configured to connect the input/output modules to the switching modules within the same chassis.

The office action rejected the claims based on the same combination of Carvey and Dally, citing particularly the sections in Carvey describing links (22--Carvey) between the module connectors (42--Carvey), where the links are formed by conductors in the backplane (40--Carvey) and in one of the configuration boards (46--Carvey) connected to the backplane. The Applicant traverses this rejection for several reasons.

First, as explained above, the connections on the backplane of Carvey run from one switch router module (as described by Dally) to another. Thus, the connections described in Carvey connect from the output (60--Dally) of one switch router module to the input (58--Dally) of another switch router module. This is true even when Carvey discusses the connection of multiple backplanes, in that such connections still only allow communication between one complete Dally switching module and another. See col. 2, lines 28-30. In contrast, claim 34 discusses the connection between input/output modules and switching modules. Nothing in Carvey or Dally suggest the use of the links of Carvey to directly connect the input and outputs of Dally to the crossbar switch of Dally.

Second, nothing in Carvey reveals two different types of communication paths, with one path being hardwired and a second passing through a jumper connection site. The citation in the office action relating to the jumper connection site refers instead to the communication path in Carvey between Dally-type switching modules. The Carvey communication path includes parallel paths (each path carrying a bit), with each path

passing over the backplane and through a configuration board (46) before leading to the next switching module. If the examiner proposes that this disclosure reveals a jumper communication path, the applicant respectfully disagrees as no such teaching is found in the passage. Furthermore, this passage reveals a single connection between modules as a whole, not two different paths with one hardwired and one passing through a jumper connection. Even if the office action is contending the parallel bit paths are multiple connections, each such bit path follows the same path across the backplane and configuration board. There is no teaching of one complete hardwired path and one path passing through a jumper connection site.

As for claim 35, the cited section (col. 2, lines 38-41) in Carvey fails to teach two connections between each input/output modules and each switching module within a chassis. Instead, this section teaches that the configuration modules (46) of Carvey can operate in one of two modes. The first mode reconnects to modules on the same backplane, and a second mode connects to modules on a second backplane. These modes are mutually exclusive. Furthermore, even if both modes could exist simultaneously, there is no teaching of having two connections between the same modules. Rather, the ability to operate in both modes would instead connect a single module to two other modules along a single output path.

Claim 36 requires that a single physical switching module be logically decoupled into separate, equal-sized logical switches, with each logical switch having a single connection to each input/output module within the same chassis. This is not shown in Carvey. The cited section (col. 5, lines 9-14) merely discusses a torus network (20) connecting multiple switches together in a fabric. Nowhere is the logical division of a physical module discussed. Furthermore, the concept of providing separate communication paths to the same input/output modules taught or suggested.

Claim 40 requires that two physical modules be logically coupled together into a single logical switch. The office action cites the same section (Carvey, col. 5, lines 9-14) for this claim. As explained immediately above, this concept is not taught or suggested in this section.

In summary, claims 34-41 all relate to a unique construction of a Fibre Channel switch utilizing multiple input/output modules and multiple switching modules. As defined in claim 34, every input/output module has two types of connections that can be used to access the switching modules. The first connection is a hardwired connection

that is made between every input/output module and every switching module on a chassis. The second is made to at least one jumper connection site. The jumper connection sites also have connections to every switching module. This construction is not found in the teaching of Carvey, which merely connects switch router modules to six neighboring modules with each connection being made through a single, parallel data path. Carvey does not teach the linking of input/output modules with switching modules, does not teach jumper connection sites, and does not teach two paths between the same pair of modules. Finally, Carvey does not teach the use of these jumper connection paths to aid in the logical decoupling of a single switching module into two logical modules, or the logical combination of two switching modules into a single logical module.

CONCLUSION

All of the claims remaining in this application should now be seen to be in condition for allowance. The prompt issuance of a notice to that effect is solicited.

Respectfully submitted,
COMPUTER NETWORK
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By its attorneys:

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